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Industrial Simulation Games for Executive Development: Review of the Literature and Implications for Military Applications

James D. Baker, Patricia A. Harris, and Kenneth W. Lucas
Allen Corporation of America

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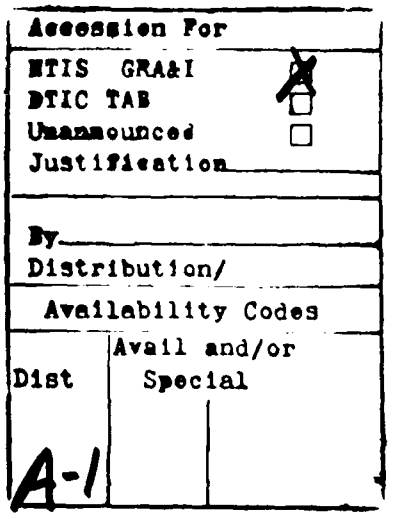

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A literature survey was conducted to assess the use of simulations for executive development in the industrial sector and to identify potentially useful applications for the development of the future leaders of the U.S. Army. Eighty-four relevant citations were sorted into categories, analyzed, and described in terms of approach, design, intended audience, and reported outcomes. While simulation training is widely used and growing in popularity, the focus of the training is generally on lower to midlevel managers. No specific data were found to confirm the learning value of simulation-based training. While no "off-the-shelf" simulations for Army executive development were identified, the survey did reveal design principles, modeling approaches, and training concepts for further analysis and research.

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Research Report 1507

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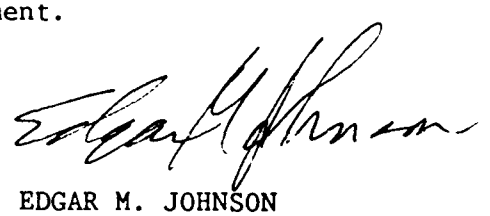
FOREWORD

This report is part of a long-range effort by the U.S. Army Research Institute for the Behavioral and Social Sciences to enhance the development of the Army's executive leaders. The overall strategy has been to identify the performance requirements of the top leadership positions of the Army, and then to focus on technologies for accelerating the development of the required skills.

Researchers identified cognitive skills, particularly inductive and conceptual skills, as the most important developmental areas for leadership enhancement. Simulation technology appeared to have high potential for use as a developmental tool. This report presents the results of a search of industry-based literature to determine whether there are current private sector concepts, modeling approaches, or specific simulations that could be useful to Army executive development.

This report has been provided to Chief, Leadership Branch, Directorate of Military Personnel Management, ODCSPER, DA, and to the faculty of the Department of Leadership, Command, and Management of the Army War College. Its primary use will be in the formulation of strategies for simulation technologies to aid officer cognitive skill development.



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INDUSTRIAL SIMULATION GAMES FOR EXECUTIVE DEVELOPMENT: REVIEW OF THE LITERATURE AND IMPLICATIONS FOR MILITARY APPLICATIONS

EXECUTIVE SUMMARY

Requirement:

To examine the use of simulations for executive development in industry as potential tools for executive-level training in the Army.

Procedure:

Researchers used the BRS Information Technologies System to perform a computerized literature search. The retrieval scheme used five terms, singly and in combination: simulation, game, training use of games and simulations, management models, and decision theory. Of the 142 references located, 84 were relevant to the research. These were sorted into 11 arbitrary information categories, analyzed, and described. Key design principles were identified and listed for Army applications, together with recommendations for further analysis of 12 promising concepts or applications.

Findings:

The literature review confirmed that simulation games are being widely used for training in the industrial community. To date, the primary focus of simulation games for "executive" development appears to be on lower to mid-level management. Additionally, there is a general absence of research data to confirm the educational value of simulations in terms of specific learning objectives.

In light of these findings, no recommendations can be made for "off-the-shelf" simulation games for Army executive development. However, design principles were identified for developing or redesigning Army simulations. In addition, 12 reports were found to include modeling approaches, design parameters, and/or skill development strategies that appear promising for further research and analysis.

Utilization of Findings:

The design principles and applications described in this paper provide a background for Army research into the use of simulation games for executive-level training. The concepts and theories identified as promising will be a useful guide for further efforts.

INDUSTRIAL SIMULATION GAMES FOR EXECUTIVE DEVELOPMENT: REVIEW OF THE LITERATURE AND IMPLICATIONS FOR MILITARY APPLICATIONS

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INDUSTRIAL SIMULATION GAMES FOR EXECUTIVE DEVELOPMENT: REVIEW OF THE LITERATURE AND IMPLICATIONS FOR MILITARY APPLICATIONS

INTRODUCTION

The Executive Development Research Group (EDRG) of the Army Research Institute is engaged in long-term research into performance and training requirements for the Army's future executive leaders -- the three- and four-star general officers and members of the Senior Executive Service (SES) who will lead the Army in the 21st Century. One thrust of that effort has been to seek potentially useful approaches and technology from industry, where programs of assessment and development have been popular for decades. Unlike the military, businesses recruit and select new employees at mid-level and above. Those recruited into senior positions often are actively trained for their new responsibilities. In addition, the industrial sector has been at the forefront of applying advanced technologies such as simulation games to human resource development.

Two earlier projects preceded this literature review. The first focused on the assessment methodology employed by industrial organizations to enhance development at the corporate level (Harris and Hendrix, 1988). The second examined current theories and processes for developing individuals into high-caliber executives. The purpose of this project is to review the literature on simulations and gaming approaches to executive development in industry and to assess their application for military executive development.

Terms and Definitions

In industry, "executive" is a popular term that is used without common definition. The games designed for "executive development" vary widely in the organizational level of individuals addressed and the complexity of the simulation. For the Army, the definition is quite explicit. Army Regulation 600-100 defines executives as those in three- and four-star grades and their civilian (SES) counterparts. The organizational levels they occupy are Corps and higher, or their equivalent.

According to the ARI's Integrated Organizational Design and Development Model (ARI-IODD), different organizational levels impose different critical requirements on incumbents (Figure 1). At the executive level, critical skills tend to be more conceptual than either technical or interpersonal, though technical and interpersonal requirements are still of consequence. For purposes of this paper, military executives are individuals who operate at the systems domain level shown in Figure 1. This corresponds to industry managers at the level of Chief Executive Officer, President, or Executive Vice President of a corporation with one or more independent operating companies subordinate to a corporate headquarters.

"Simulation" also has various meanings, depending on scientific community. To the military Operations Research/Systems Analysis (ORSA) community, the term is synonymous with large machine simulators used primarily for weapon systems or force structure evaluations. A survey of

Functional Domain	Stratum
Systems Domain -- Operates in a nearly unbounded world environment, identifies feasible futures, develops consensus on specific features to create, and builds required resource bases to whole systems which can function in the environment. Conditions environment to be "friendly" to systems thus created. Creates a corporate culture and value system compatible with societal values and culture, to serve as a basis for organizational policies and climate.	VII ARMY --- VI CORPS
Organizational Domain -- Individuals at Stratum V operate bounded open systems thus created, assisted by individuals at Stratum IV in managing adaptation of those systems within the environment by modification/maintenance/fine tuning of internal processes and climate, and by oversight of subsystems.	V DIVISION --- IV BRIGADE
Production Domain -- Runs face-to-face (mutual recognition or mutual knowledge) subsystems -- units or groups engaged in specific differentiated functions but interdependent with other units or groups, limited by context and boundaries set within the larger system.	III BATTALION --- II COMPANY --- I PLATOON

Figure 1. Functional domains and corresponding Army strata in ARI Integrated Organizational Design and Development model.

the ORSA community, conducted by the Rand Corporation (Shubik and Brewer, 1972), concluded that distinct definitions acceptable to all military ORSA experts could not be derived for the terms "model, simulation and game." As a result, they clustered them into a single term: "MSGs."

Both simulation and games derive from models. A model is a representation of certain aspects of complex events, structures or systems, made by using symbols or objects of the item being modeled (Chapanis, 1961). For this review, the model is assumed to be structured to reflect the executive's world. Simulation may be defined as a learning process in which an individual acts as a participant in simulated real-life situations (e.g., the interactive videodisc simulation developed by Digital Electronic Corporation to prepare executives for interpersonal counseling sessions). Gaming is an activity in which learners compete physically or mentally according to a prescribed set of rules (e.g., the AMA Top Management Decision Simulation business game).

For the purposes of this paper, the definition is a combination of the two: simulation games. In Figure 2, the characteristics of games and simulations along several attributes are presented and then combined to define the characteristics of game simulations. In the course of this discussion, the term "simulation" may be used alone to refer to that combination of simulation and game that produces learning.

Another distinction when discussing simulation games for executives is that of training versus education. Training implies a structured learning environment that is outcome oriented, job based, and assessed in terms of specified performance standards. Education, on the other hand, is more school based, process oriented, and general in nature. This distinction is blurred for the conceptual skills that are the major requirement in the executive domain. While it seems likely that these "thinking" skills can be trained, performance standards are either absent or in the early stages of development. This paper will use the term "executive instruction through simulation," where instruction includes both training and education.

The value of a simulation game lies in its instructional effectiveness. Engineering and psychological simulations provide a useful contrast in the types of data used to derive effectiveness measures. Engineering simulation duplicates the functional characteristics of operational equipment. Thus, effectiveness measures typically are electro mechanical measures of the simulator itself, evaluated in terms of how closely they match the actual equipment or system being simulated. Psychological simulation is related to skill transfer from the simulation to the operational setting. Instructional effectiveness, as used here, refers to measures of psychological simulations and has been described by Gagne (1962) as follows: "When one inquires about the effectiveness of an instructional device, one is really asking about the transfer of learning to some criterion." Reported instructional effectiveness was one criterion used in assessing the utility of the simulation games discussed in this literature review.

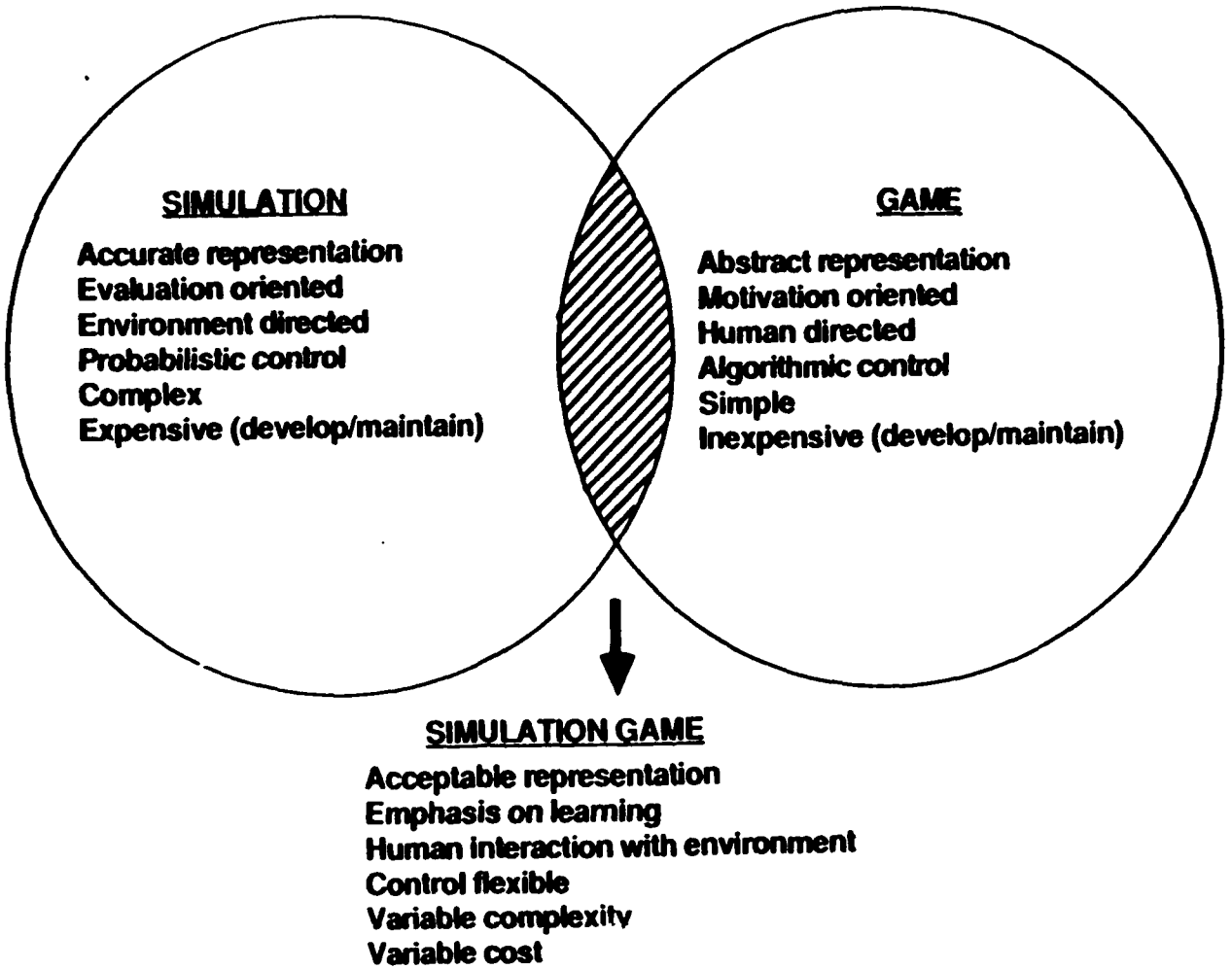

Figure 2. Relationship of Simulation to Game

Approach

Literature was identified by computerized search, using the BRS Information Technologies System. The retrieval scheme used the terms defined in the introduction of this paper: simulation, game, and the use of games and simulations for training, as well as management models and decision theory. Of the 142 references found, 84 were relevant to the research. These were sorted into 11 arbitrary information categories:

- overview reports of the application and value of simulation games
- strategic
- international
- crisis management
- project management
- personality assessment
- special instructional games (e.g., training and retail sales)
- computer-based simulation games
- simulation game design considerations
- structure and theory (with an emphasis on Bayesian Theory)
- reports that described the use of simulation games for experimentation and/or contained any information about performance criteria

Some references applied to more than one category and will appear more than once in the following discussion.

OVERVIEW REPORTS

The literature in this area was found to be generally broad in scope, and often without substantiating detail or quantification. Twenty percent of the reports reviewed were general discussions of the perceived benefits of simulation games. While many contained valuable lessons learned, few dealt with quantified evidence to support usefulness of application.

The reviews are presented in two groupings: (1) general reviews of simulation games and their applications, and (2) reviews of specific simulations developed for either individual or wide-spread application. The general reviews are discussed chronologically so that emerging trends in simulation games can be noted. Earlier reviews tended to focus on the the use of simulation games to train first-line to mid-level managers,

enhance existing managerial skills to achieve greater productivity, or assess individual potential. It appears that the notion of developing conceptual and cognitive skills through simulations did not surface until the mid 1970s.

General Reviews

Fleming (1969) viewed management games as an important teaching tool in management development programs. The objective of such games was seen as an opportunity for players to study the small-group processes that took place: team organization, work load, information flow, group effectiveness, and interpersonal relationships. The value of such games, according to Fleming, was the development of an increased self awareness and identification of the players' own management weaknesses.

Crane (1972) cited role playing, case incidents, in-basket simulations, group discussions, and participative training methods as the tools most used by business in management training programs. His survey of business trainers showed a predominance of participative training techniques. The majority of trainers used role-playing techniques followed by group discussions. All of the techniques he examined were successful, but he cautioned that success was dependent on the trainer's skill in application.

Rawls and Rawls (1974) noted a trend in management selection toward tests that focus on job-relevant behaviors. There is movement away from the use of a single global criterion and toward increasing use of in-basket simulations, management games, and group interaction exercises. As a spin-off, these management selection techniques are providing information which can, in turn, be used for establishing learning objectives.

Lloyd (1978) explored the relationship of the major aspects of business or management games to other instructional media. For example, from a trainee's point of view, a game can show how various aspects of a lecture or film fit together in a practical way. Lloyd divided games into three broad categories: (a) business games that incorporate a full range of decision making in activities such as finance, personnel, production, research and development, marketing, and forward planning; (b) functional business games that cover one specific aspect of an activity; or (c) technical games. Lloyd also ascribed essential objectives for running a game: illustrating points already made; illustrating general management principles; demonstrating the importance of organization and communication while, at the same time, providing practice; adding interest to a course; or promoting understanding.

According to Murphy (1980), every management game should contain four key features: (a) simulation, (b) feedback, (c) competition, and (d) time-scale. Recommended applications included: (a) motivation/ participation, (b) presenting knowledge, (c) encouraging skill practice, (d) provoking desired behavior, and (e) stimulating thought. A primary

criticism of management games was that they often bear no relation to what occurs in reality. Advantages cited for management games were that they could be used to demonstrate interrelationships of functions, provide the opportunity to practice and assess what has been learned, and highlight group behavior. Disadvantages were that they are time consuming, stressful, typically unrealistic, and often result in the trainee becoming so involved in the process that he fails to learn. Murphy suggests the following guidelines for a trainer using management games: (a) define clear and specific objectives, (b) provide feedback and conduct lessons during the game as well as a comprehensive review at the end, and (c) establish realistic expectations for the game and its outcome.

Hunter and Price (1980) described business games as under-used learning tools. They felt that whole-company games capture the real and sometimes chaotic world facing management and are useful tools for diagnosing and honing management skills. They noted, however, that business games have grown slowly and their acceptance by corporations has been unpredictable. One reason for this slow growth is attributed to the lack of clear evidence of business games' educational worth.

Partridge and Sculli (1982), at the University of Hong Kong, investigated the effectiveness of business games in developing business skills. Data were collected from three business game competitions that used participants from all levels of management and office staff. General findings were that management training programs should contain an amalgam of business games and case studies. They reasoned that gaming emphasizes information processing skills for decision making under ambiguity, while case studies tend to draw out peer and leadership skills from participants.

Ginter, Rucks, and Andrew (1983) described the key factors essential for industrial strategic management models: (a) assessment of internal and external threats and opportunities, (b) setting objectives, (c) identification and evaluation of alternatives, (d) strategy formulation and evaluation, and (e) contingency planning. Because such models were often seen as understated or piecemeal, they emphasized wargames that simulate military operations among opposing forces using rules, data and procedures designed to depict an actual or hypothetical real life situation. Theater-level wargames were noted as conceptually similar to strategic level business.

The same authors looked to wargames to provide the insights needed to structure business games (Gagne et al., 1984). Military contributions to the field of strategic decision making through the use of war games were seen as significant. The concepts could be useful to business managers for expanding strategic decision making judgment and as aids to decision making. Noted limitations focused on the anomalous nature of strategy formulation and on the communication problems between model developers and model users (decision makers).

Petre (1984) reviewed the large-scale simulation exercises for management training that are increasingly popular with firms 'ike International Business Machines (IBM), Union Carbide, and Monsanto. Elaborate simulations of corporate life feature chains of command, overflowing in-boxes, and telephone calls answered by phantom underlings. During the simulation, the management trainee is confronted with a number of problems that must be solved within the context of the hectic disorder of a typical business day. These simulations are seen as gradually reshaping the way companies train their executives. Looking Glass, Inc., produced by the Center for Creative Leadership, is the oldest and most widely used management simulation exercise. Two relatively new offerings are Financial Services Industry and the Simmons Simulator. Petre observed that many companies are convinced of the benefits of simulation games, even in the absence of hard evidence on how well the games accomplish corporate training objectives. IBM is so convinced of the value of the company-commissioned Simmons Simulator that it is denying use of the simulator to competitors.

Fripp (1984) hypothesized that business games are ideally suited for educational purposes because they can be made to embody all phases of the learning cycle. Although the games tend to be complex, Fripp suggests that the level of complexity is not directly related to effectiveness. He listed the following types of business games: (a) functional, (b) whole-company (e.g., Looking Glass), (c) skill development, and (d) strategy. Design selection depends on the desired results to be achieved, requires vigorous testing and refinement. Properly designed games can offer the best of two opposing types of learning experiences: (a) examples of real and varied behavior and (b) a rigorous and practical framework from which results of behavior can be assessed in quantitative terms. Similar to the previous overviews, Fripp's endorsement of simulations was not based on quantified results.

Roman (1985) described computer-generated simulations as a way to allow employees to experience realistic work conditions or situations with an element of danger or emergency without jeopardy to the employee or the business. In his opinion, simulating management decisions does not require sophisticated visual representations, but only printouts of data. In Roman's words: "Unlike lectures which are often directed at passive listeners, computer-based simulations require participants to react."

Gordon (1985) noted a change in the type of exercises used by managers in the last six years. He cites Looking Glass and the Financial Services Industry Simulation as examples of games that do not require the direct use of computers. He suggests that both are designed to identify and analyze the behaviors of individuals and groups, requiring trainees to use strategic and tactical planning to make decisions in a hypothetical context. These games try to teach managers, currently concerned with specific functional areas, how to think like top management by forcing them to experience the ways in which decisions made by one department affect other departments. According to Gordon, personal computers are a valuable addition to mainframe simulations that

date back three decades. New games are being developed, together with adaptations of traditional games from mainframes. The Strategic Management Game, developed at the University of Pennsylvania, is one example. It comes in a generic version, as well as in specialized versions for manufacturing, service, health care, and wholesale distribution industrial applications.

Wehrenberg (1985) described the application of game simulation to reinforce learning, to employ new/unusual strategies, and to experience different situations in a positive atmosphere in which bad decisions had no cost implications. He described a unique application of simulations to illustrate sexual harassment and racial discrimination in the workplace and their related leadership issues. He assessed that although games have limitations, they can improve learning by generating active participation and knowledge that can be transferred to the actual work environment.

Reviews of Individual Simulations

Wahi (1972) was among the first to elevate the use of simulation games to training managers at the indirect organizational level. His interactive business simulation game focused on the development of skills needed to make business decisions and evaluate new ideas. The game introduced formal, quantitative techniques of decision making. In Wahi's view, the use of management games in the business world is comparable to the use of lab experiments in the physical sciences. The results of good or bad decisions can be examined without fear of real loss.

Uretsky (1973) described a unique man-machine simulation that enables graduate business students at New York University (NYU) to simultaneously gain an integrative experience and interact with the surrounding community, all within a relatively controlled structure. A unique feature of the game is the extent to which it employs an embedded mentoring concept. Participants are divided into groups representing the middle and upper management of a corporation. Each group has control over all operations of their respective company: production, marketing, and financial transactions. The computer carries out the decisions, performs day-to-day operations, evaluates competitive interactions, and reports results.

According to the Chairman of the Board of Xicom, Inc., one of the greatest managerial challenges is channeling the energies of those employees who want to transform their responsibilities as individuals into positive efforts that are beneficial to the organization as a whole (Gottheimer, 1978). To this end, Xicom developed a training laboratory that stimulated managers and staffers in the use of thinking skills. The program used simulations of dramatic, real life situations to foster discussions and creative means of looking at problems.

In the United Kingdom, the City of Bradford's Metropolitan workforce tested an experimental training approach (Kemp, 1979). The objective was to provide a greater awareness of interpersonal skills, process dynamics at group and organizational levels, decision making skills within

consensus groups, skills in managing relationships with colleagues and inter-group conflict, and attitudes toward issues such as authority and leadership. The report contained no substantiating data. However, the insight derived from the experiment was that learning and growth are best facilitated by an integrated process that includes: (a) here and now experience, (b) collection of data and observations regarding the experience, (c) analysis of the data with conclusions fed back to the trainees, and (d) use of the conclusions for behavior modification and choice of new experiences.

A New York firm, Planning and Control, Inc. (Staff, 1980), offers a management training technique using computer simulation programs to duplicate different work environments including personnel, production processes, and reports. Unscheduled personnel absences and acts of God are built into the simulation to add realism to the simulated work environment. While participating managers seek to identify corporate problems, computer-generated reports apprise them of their progress in terms of: (a) productivity, (b) unit costs, (c) quality and (d) staffing. According to PCI, functional as well as leadership skills were learned as a result of the intense interactions and group dynamics.

STRATEGIC SIMULATION GAME REPORTS

Of the 84 applicable reports reviewed, only four were found to be oriented to strategic simulations.

Rothschild (1971) described a strategic simulation game developed at the General Electric Management Institute. In his view, computer-assisted simulation exercises (CASE) can be an effective tool for accelerating the growth of general managers. Organizations need managers who can perform strategic planning and then translate the strategy into operational plans. They need to assess the environment, evaluate resources, determine alternate strategies, and then manage the effort so that the organization meets specified objectives. General Electric designed CASE to provide experience in using specific, sequential processes unique to GE's applications.

The Strategic Planning Institute (SPI) in Cambridge, MA, in cooperation with some of the largest corporations in America, undertook a detailed computer study to determine whether the "laws of the marketplace" actually apply to actual business situations (Kilgore, 1977). They also looked at whether such factors as profitability or market share actually help businessmen make everyday strategic decisions in the market place. Data from 150 corporate clients, about half of them Fortune 500 companies, were broken into manufacturing entities for analysis purposes, enlarging the data base to over 1,000 "businesses." The Profit Impact of Management Strategy (PIMS) program derived from the data enables the development of a strategy change or alternative strategies for clients.

Karnani (1984) noted that the idea of generic strategies for gaining competitive advantage was receiving much attention in the business policy field. The two generic strategies usually addressed are low cost position and highly differentiated position. A game-theoretic model of oligopolistic competition is employed to provide analytic support both for testing these generic strategies and refining the conclusions from previous relevant research. One conclusion drawn from this work is that a superior cost or differentiation position results in a larger market share which, in turn, leads to a greater profitability. This game-theoretic model helps to underline the distinction between cost position independent of scale and position in terms of costs.

The Financial Services Industry's (FSI) behavioral simulation program was developed at New York University (Soat, 1984). FSI duplicates a day in the life of senior level management in either of two fictitious financial service organizations. As a training tool for strategic and tactical thinking in middle and upper level management, the program's goal is to focus on behavioral aspects of strategic management within a dynamic organization. The three-day simulation involves such exercises as goal setting and role playing. Participants receive background information prior to attending the program. General information is discussed during the first day. On the second day, discussions consist of the meetings and problems of the fictitious organizations, and the third day is used to examine the decisions made the day before. Extensive feedback about performance is provided as trainers observe the process and report on management behavior within the simulation.

INTERNATIONAL SIMULATION GAME REPORTS

One of the characteristics of the military executives operating in the Systems Domain in Figure 1 is that they operate in an unbounded, international arena where socio-economic, political and cultural factors are extremely important. International business simulations were included in the review as a potential source of experiential learning in this area of executive performance. Nearly a dozen reports of relevant simulation games were found. Suprisingly, the eastern bloc countries originated the earliest reports on the use of this type of simulation game.

Hlavsa (1969) of the Research Institute for Administration and Automation in Prague, Czechoslovakia, identified methods to stimulate and cultivate various kinds of creativity. Among the methods described were (a) management and economic games, (b) daydreaming, (c) new attitude creation, (d) drugs, and (e) hypnosis. Facilitation methods considered are (a) heuristic methods, (b) self-questioning, (c) problem analysis, and (d) "brainstorming." The approach taken by Hlavsa seems to be unique to this research institute.

Blanning and Kisiel (1974) described the development of a simulation game at NYU to train Polish industrial managers. The approach was to use an NYU business game as the skeleton and incorporate characteristics of the Polish economy. Specific factors in the Polish industrial system required changes in game procedures as well as in the manufacturing, marketing, and financial components. While substantial reprogramming was required, the most difficult part was reported to be modifying the model so that the simulation would appear realistic.

The Soviets have also been active in developing business simulation games. Gidrovich and Syroezhin (1982) found that business games are popular among cybernetic management theorists in the USSR. They view simulation games as providing the advantages of: (a) knowing the consequences of decisions; (b) changing time frames; (c) analyzing alternative conditions; (d) increasing the complexity of problems, and (e) reproducing the national economy. Business games have been used in the USSR to test the competence of managerial personnel, for research and for decision strategy. A primary function of Russian business games is educational, allowing management students to role-play in specific situations. Designing their educational games involves: (a) determining the object of the modeling; (b) selecting the type of game; (c) defining objectives; (d) structuring model connections; (e) determining labor and material resources; (f) defining functions and parameters; (g) gathering data; (h) simulating environmental influences; (i) developing rules, fines, incentives, and (j) testing and adjusting the system. This, of course, is a general blueprint for the design of any managerial or executive level simulation game.

Assa (1982) discussed a project in which scientists from six socialist countries developed a new tool for systems analysis in large socioeconomic systems. Advantages of using gaming in systems analysis included: (a) a determination can be made as to whether problems can be solved by methods other than gaming; (b) the roles that people play in gaming can be ascertained; (c) assessment of whether the game converges to an optimal solution is possible; and (d) a determination can be made concerning the practical problems successfully resolved through gaming. Although the article focused more on an ORSA-type simulation approach, it provided an additional example of the socialist world of business simulation and gaming.

The Japanese often use a different approach to decision making and gaming. According to Howard and Teramoto (1981), Japanese employ a cybernetic game approach to business decision making that includes religious and philosophic differences. The most important differences between Japanese and Western management are at the "meta-cultural" level. Social practices are not as important as the ability to understand the functions of these practices. Western observers tend to focus on Japanese industrial customs such as lifetime employment and payment by seniority. These Japanese attitudes generally emerged only after World War II, introduced by Western industrialists. For the Japanese, decision making is a cybernetic gaming process that includes

many variables that Westeners tend to ignore. The Japanese concept of nemawashi -- tree planting -- connotes all the terms Westerners use to describe decision making. Howard and Teramoto believe that Westerners could apply the scientific approach to nemawashi and thus learn how to deal with the Japanese at their own level.

The Japanese are also attuned to traditional business simulation games and capitalize on them for training managers in both U.S. and Japanese business techniques. McAbee (1981) reports that Sony Corporation of Japan markets a management training simulation game that uses pencils, paper, chips, and cards instead of computers. The game resembles a complex version of Monopoly and is played over a three-day period in a seminar session. The game offers Americans an insight into what shapes Japanese corporate strategy and takes the participants out of their normal business specialities, forcing them to look at business as a whole. Sony's personnel division created the game in response to a request for a mode of training more stimulating than reading and lectures. The game, which took thirty months to design, offers both an industrial and commercial version translated into South Korean, Mandarin Chinese and French.

Hill (1985) noted that games simulating international competitive business situations are becoming more popular, as are games that are custom built for particular companies. These games are also becoming increasingly sophisticated for both the provider and user. According to Hill, because realistic games provide better learning opportunities, users want simulations that reflect real life. Although games are not well received in all countries or companies, they have been credited with developing good interpersonal skills and in helping managers make integrated decisions.

Lee and Speidel (1985) described the work being done at the National Center for Industrial Science and Technology Management Development in the Peoples Republic of China. The Center, jointly administered by China and the U.S., educates senior Chinese managers and professionals about U.S. management practices. The basic program for "enterprise managers" offers a 6-8 month curriculum similar to that in U.S. business schools. In addition to lectures, students are introduced to the case study method and computer-based management simulation games. Another scheduled joint venture is the Center for Chinese and American Studies that will be offered by Nanjing University and the School of Advanced International Studies of the Johns Hopkins University. The goals are to: (a) provide advanced training for young professionals interested in careers involving U.S.-China relations, (b) prepare graduate students for study in either country, and (c) provide a meeting place for discipline specialists.

The report by Borsig and Frey (1979) falls into both international simulation games and games used for experimentation. In the study, 96 German business administration undergraduates were placed in egalitarian or hierarchical groups and asked to solve a business management game. Half of each of these groups were then provided an optimal problem solving method derived from operations research techniques. Both groups

reported significantly more satisfaction when making decisions with the optimal problem solving method. The hierarchical group reported the greatest overall satisfaction.

As might be expected, international banking has also been a focus for simulation games. Galitz (1983) reports that management gaming exercises are becoming increasingly important to education and training in the banking sectors. The rationale is that people learn more effectively by discovering and experiencing something for themselves than through formal instruction. InterBank, an advanced gaming exercise, was designed to show participants the complex links, relationships, and tradeoffs that characterize banking today. Developed at the University College of North Wales, InterBank provides players with recognizable, controllable, and acceptable feedback. Teams must make decisions regarding lending, deposits, investments, corporate operations, and general banking areas. According to Galitz, management gaming provides an excellent means of combining the acquisition of theoretical knowledge with practical experience.

CRISIS MANAGEMENT SIMULATION GAME REPORTS

The skills that comprise crisis management would seem to be an important component of military executive development. Seven reports dealt specifically with simulation games for emergency response and crisis management.

A simulation called "The Superior Commander" is described by Cooper (1979) as a new methodology for the design and control of experimental games that expose players to crisis or stress. The game technique sets an environment in which: (a) the player can accept the game as realistic because it contains sufficient complexity and detail, (b) the player believes that he is an active decision maker, and (c) the experimenter is able to control the game so that it can be replicated for different players. "The Superior Commander" was developed to overcome some of the limitations of other game playing approaches to the study of decision making in crisis. Cooper states, however, that it is also a general methodology for research games and is applicable to a range of purposes that require realism and good experimental control.

Cox and Mosser (1975) discussed programs used by Gulf Oil to prepare key personnel in crisis management. The approach included building the mythical city of CrisisPort, transferring managers there for training, and creating a series of communications and community relations problems. Initial results were that the managers were not ready for the crunch and were hindered by Gulf's stringent, standardized policies. In response, Gulf altered communications policies to allow local management to represent Gulf in each community and ordered the Public Relations department to train 1300 new public communicators. The result was a 400 percent increase in positive publicity statements about Gulf in the Philadelphia area. However, a causal relationship to the simulation has not been documented.

Spain (1978) reported on Gulf's disaster communications training program. Gulf's policy is that each manager in its worldwide operations is responsible for public relations. The training program, also presented at CrisisPort, simulates several different types of disasters with assigned managers directing the communications that would be required. Gulf designed a second, similar program to deal specifically with oil spills. According to Spain, benefits already derived from these two programs include reduced oil spills and more effective public communications when an oil spill does occur. However, no evidence was presented to document a direct correlation between the training program and subsequent events.

Groth and Phillips (1978) discussed general crisis management and the role of simulations. They list communication, leadership, and authority delegation as key factors in successful crisis management. The authors identify two requirements in a crisis situation: (a) positive action and (b) efficient use of time. While a company cannot predict specific crises, it is possible to plan and train for major possibilities. Additional benefits may also accrue as the planning process and training methods overflow into the routine operations of the firm. These authors believe that a CEO should not participate in simulated exercises, but should observe the reactions of the team members to the crisis scenario.

RISKM, described by Schott (1976), is a generic risk management simulation game developed at Georgia State University to provide a risk-management learning laboratory. Students compete with their peers in selecting or developing management policies and decisions, inputting decisions on a time-sharing computer. In order to compare performance, a large number of "chance" factors are held constant among students. Financial reports present the effects of risk management strategies on overall operations of the hypothetical firm.

Information technologies have great potential for improving emergency management, especially in the area of public education. One effort, described by Morentz (1985), is a program recently initiated by the Federal Emergency Management Agency (FEMA) and sponsored by a Emergency Public Information Competitive Challenge Grant. The Center for Application of Science and Technology to Emergency Management currently is developing computer games that teach the public emergency management techniques. "Saving Lives: The Emergency Management Game" will be designed for groups of users ranging from young children to adults. Topics will include hazard awareness, preparedness actions, warning responses, event behavior, and recovery behavior. This program is in the early stages of development.

Neuman and Singer (1982) describe a simulation in which a crisis management team (CMT) is tested against the extortion kidnapping of a company executive. The simulation begins with a film and includes press conferences, ransom demands, negotiations with the terrorists through an intermediary, medical problems with the victim, and State Department and Federal Bureau of Investigation liaison. The simulation uses four types

of materials: the basic background kit, on-request background material, pre-programmed materials, and simulators. The CMT and a data processing team are both involved in the simulations. Company-specific scenarios as spin-offs from the simulation have been found to be extremely valuable.

PROJECT MANAGEMENT SIMULATION GAME REPORTS

One focus of simulation games in industry is on project management training. This class of activity would normally fall in the Organizational Domain (Figure 1). However, if earlier preparation of individuals is a goal, tools used at this level may also be applicable.

Pamukcu and Pruett (1985) state that teaching quantitative approaches to management is a fairly clear task that has been performed for a number of years. Teaching the principles of project management is an entirely separate task that deals with all phases of a project, from the beginning of the planning procedure to the physical completion of the whole effort. The process involves a sequence of planning, decision making, follow-up activities, and reevaluation, followed by a repetition of this sequence. The Interactive Project Management (IPM) game simulates this dynamic process and is intended to teach project management principles in a simulated project setting using a computer as the delivery system. While Pamukcu and Pruett describe the intended features of the game and its assumed capabilities, the game was still being developed and has not been evaluated. The approach appears similar to the program initiated recently by the Defense Systems Management College (DSMC) to look at the development of simulation games for teaching the project management process in the context of the military's Life Cycle Systems Management Model.

Karnani (1984) also focused on the project management process. He began with the philosophic observation that conventional wisdom in business policy and marketing suggests that the approximate strategy regarding market share depends on the stage of the product life cycle. However, many questions must be answered before the strategy can be implemented (e.g., is it possible to compare the value of market share in different markets?). Karnani describes a dynamic, game-theoretic model of marketing competition in an oligopoly created with the goal of answering such questions. An equilibrium solution to the model is used to investigate how a firm's optimal marketing expenditure per unit sold (a measure of the value of the market share) depends on current and future marketing demand, which also can be related to the product life cycle. His findings to date support the conventional wisdom that the earlier in the life cycle, the greater the value of the market share. Karnani's work is more akin to an ORSA type approach than a game simulation.

With the exception of life insurance applications, project management simulation models in the insurance industry have not kept pace with other industrial applications, according to Galitz (1984). In an attempt to bridge the gap, a research team from the Institute of European Finance,

at University College Bangor, developed an advanced simulation model for insurance and reinsurance (ASIR). Begun in 1978, the objectives of ASIR were: (a) to create a powerful and flexible computer-based modeling system to facilitate experimentation with insurance and reinsurance companies and their interface with the operating environment, and (b) to apply the system to the benefit of the insurance community. Galitz reports that ASIR was designed to enable the casual user to define an insurance company and a set of management strategies for purposes of research, short range planning, long range planning and/or "education and training." In this case, education and training are based on osmotic, hands-on experience in an uncontrolled learning environment.

Agin (1983) presented a more optimistic view regarding simulations in the insurance industry. He described the Computer Assisted Simulation Exercise (CASE) system, developed for the General Reinsurance Corporation, as an aid for insurance executives who make decisions that could affect the future success of their organizations. Two of the CASE exercises, the Reinsurance Operation Simulation Exercise (ROSE) and the Primary Insurance Management Exercise (PRIME), are designed to acquaint participants with the decision making process in insurance operations. Benefits to the participants include a better appreciation of how their jobs fit into the organization and a wider perspective of the entire business operation. ROSE and PRIME use representative mathematical models to simulate the real world. The ROSE/PRIME CASE system reportedly provides a cost-effective means for training insurance personnel.

An article in Banking (1978) described a simulation game/training program developed jointly by the American Banker's Association and the Federal Deposit Insurance Corporation for the Stonier Graduate School of Banking. The article focused on one test of the program that involved 45 members of the Indiana National Bank's top management team. The young age of these management players and the specialized nature of their work was of particular interest. The primary goal of the exercise was to develop a common language among the players and to show them how their decisions affect other areas. The bank's officers also felt that the program would contribute to increased recognition of the problems and opportunities from legislative changes and a rapidly escalating technological environment. The results were highly positive, with the young managers reporting that the program gave them an insight into the possible effects of their day-to-day decisions.

PERSONALITY ASSESSMENT SIMULATION GAME REPORTS

Simulation games have also been applied to the general area of personality assessment. The focus for much of this work is on the impact of an individual's personality and decision style on group/organization performance. There appears to be limited use of these games by industry in management development programs.

Jones and White (1985) used a simulation game setting to study the effect of an individual's personality on group task effectiveness. They focused on three conflict resolution modes (smoothing, forcing, confrontation) and tested four variables (affiliation, deference, aggression, Machiavellianism) for association with a preference of one or more of the modes. After participants were observed interacting during a policy simulation game, two personality measurement instruments were administered to each participant. Preference for conflict resolution mode was measured by using the 12-item Lawrence and Lorch instrument. Group effectiveness was measured by how well each group played the game. The results showed a linkage between personality characteristics and preference for conflict resolution modes. Group effectiveness appeared to be reduced when the group assumed a mode different than the preferred conflict resolution mode. A confrontational mode is apparently the most effective in terms of task accomplishment.

Hoffmeister and DiMarco (1977) used the Financial Management Decision Game (FINGAME) to examine the relationship between personality and performance. Personality characteristics that were examined included achievement, order, autonomy, endurance, time competence and locus of control. No statistically significant relationship was found between any of the traits and game performance.

Two articles on transactional analysis were included in this category of the literature review. Martin and Pendse (1977) reported that such ORSA giants as Churchman and Schainblatt have viewed the implementation of operations research/management science (OR/MS) recommendations as an interaction between the manager and the management scientist. Transactional analysis (TA) has been applied to the study of two-person interactions and the "games people play." The authors proposed that the value of TA and game playing in modeling the implementation of OR/MS in organizations is to minimize the games we know are being played and get on to the more serious task of implementation. In the same vein, Meininger's book (1973) presented practical applications of TA theories to the problems people find in organizations, to behavior change, and to goal clarification and draws upon standard ORSA techniques to support his approach.

SPECIALIZED INSTRUCTIONAL SIMULATION GAME REPORTS

A relatively few specialized simulation game reports were found during this review. One explanation may be that since considerable effort and resources are required to build simulation games, developers concentrate on more generic simulations with a larger target audience.

Two typical efforts were targeted at the retail sales community. McDevitt and Watson (1978) reported on a probabilistic, non-interactive management game developed to analyze how managers approach the idea of probability assessment. The study analyzed how 26 managers in a retail food industry controlled the inventory level of a new product in an uncertain environment, given certain probability distributions. As the

game progressed, the difference between actual and assessed values decreased, revealing a learning process. At the conclusion of the game, 70% of the participants could accurately define the demand distribution and approximately 60% were able to define the discount demand distribution.

A study on the effects of two formal training methods in the retail sales arena was reported by Ivancevich and Smith (1981). The methods involved (a) role playing and videotaping (VT) and (b) lecture and role playing (RP). The hypothesis was that sales representatives who were subordinates of trained sales managers would have more positive attitudes, more job satisfaction, and better performance than sales representatives of non-trained managers. Evaluators indicated that trained sales managers were more effective in post-training simulations than their non-trained counterparts. Pre-training and post-training evaluations of representatives' attitudes and performance suggested the superiority of formal goal setting training over the traditional approach used by non-trained managers.

Lourenco and Glidewell (1975) developed a specialized game that used dialectical analysis to explain the conflict between a local TV station and its company headquarters. The conflict centered around the perceived abuse of authority by the parent organization. Resolution of the conflict was achieved through synthesis of opposing views; however, it resulted in a more complex control structure. Conflict and its resolution were also analyzed by imposing a dialectical framework on a mixed-motive game theory. Among the conclusions reached were: (a) the concept of differentiated bases of power could be used to delineate both conflict and conflict resolution and (b) conflict and conflict resolution could be analyzed as mixed-motive games.

Edney (1979) discussed a specialized simulation game developed for the problems that arise when a community consumes resources at a rate high enough to endanger the regenerating resource itself. He recommends the game for behavioral studies concerned with resource shortages and also as a device for teaching the value of cooperation in resource management.

SIMULATION GAME DESIGN REPORTS

In the area of simulation game design, both computer-based and traditional games were reviewed. Eliason (1973) compared the design features of a business gaming environment that uses a closed model (e.g., the closed feedback loop of a computerized simulation game) to that of a traditional business management game. In this case, a business decision simulation was defined as a sequential exercise structured around a model of a business operation. Factors of the closed and traditional model designs included the environmental subsystem, the information subsystem, the decision subsystem, and the gaming design. The conclusion was that

closed games, with feedback loops and integrative designs, tend to broaden educational scope and provide an experimental medium for management research.

The assessment center concept, according to Slevin (1972), was designed to handle management appraisal and development of a much broader scale than individual testing in the conventional manner. The person being assessed is observed in a variety of settings such as management games, case analyses, discussions, and interviews. Assessors are specially trained to note examples of specific behaviors on predetermined lists of dimensions. The process results in: (a) a report to top management, providing a basis for promotional decisions, (b) a method of optimally matching an individual to the requirements of a specific position, and (c) optional constructive feedback to the participant.

Lewin, Dubno and Akulu (1971) addressed the design of peer rating systems employing simulation games and the importance of face-to-face interaction in the peer rating process. Peer ratings were obtained from two groups. The first involved group members participating in a management game. The second group viewed 15-minute videotape segments of the other group participating in the decision-making process of the game. The research revealed no differences between the two sets of peer ratings, leading to the conclusion that face-to-face interaction is not a critical variable in a peer-rating process.

THEORY AND STRUCTURE OF SIMULATION GAME REPORTS

"Game theory" is an analysis technique that involves intricate laws of strategy: how to adopt the best variations in play to avoid being beaten by an adversary and how to make the best of a bad situation or avoid the worst of a good situation when faced by a fully rational, fully analytic competitor of known means and resources.

In game theory models, "games" is a generic term, incorporating conflict situations where the success of one party tends to be at the expense of the other. For example, a two-person zero-sum game is a situation where the rankings of the payoffs by one party are the exact reverse of the rankings of the other party and the utility functions of the two parties over these results sum to zero for any given payoff. These definitions are key to a review of game theory and game structure.

Game Theory Reports

The consequences of taking a subjective view of probability for game theory were investigated by Kadane, Larkey, and Harsanyi (1982). The subjective view of probability focuses on the distinction between normative and positive theorizing about behavior in games, a distinction that has often been lost in the search of "solution concepts." Solution concepts assume players will behave in a rational manner. This idea has largely characterized game theory since the work of Von Neuman and

Morgenstern in the 1940s. Kadane and Larkey, on the other hand, believe that to assume complete predictability about one's opponent does not portray the "real world" and can lead to extreme errors.

Todd (1978) disagreed with the notion that management is a zero-sum game with the sum of the winnings equal to the sum of the losses. He asserts that the loss of power or control on the part of managers is not equal to the increased power among employees. Rather, the amount of control exercised by employees can enhance management control. He believes that employees who perceive themselves as having personal control over their jobs tend to be the best performers. Because managers channel subordinates' efforts toward achieving organizational goals, he reasons that better performance by subordinates furthers the control of management. Thus, increased control does not jeopardize manager's control.

In game-theoretic models, linear decision rules are often used to model decision-making and apply managerial intuition. Remus (1978) examined Bowman's managerial coefficient theory in the context of a competitive executive game. The experimental data revealed that linear decision rules fit the data well. He also found that erratic and biased decision making was a linear function of rank. Consistent with oligopolistic theory, learning did occur in the Executive Game, with the weakest oligopolistic effect found in marketing policy. Remus concludes that the application of Bowman's theory in a competitive environment is now established and that his work has extended the theory.

Oligopoly theory also was the focus of the work reported by Lyons (1982). Oligopoly refers to a situation in which there are a few competitors who can control the market by banding together. Group decisions are aimed at gaining maximized benefit for the group while providing a fair share for each group member. Lyons described a computer-based game designed primarily for management information systems research. The game was developed at the U.S. Naval Postgraduate School in Monterey, California In the game, each player controls a firm that faces an oligopoly market. Players must choose markets based on a number of variables including production, money, and time. According to Lyons, the game provides a controlled environment for studying information gathering and decision making.

The linear programming techniques just described work best under conditions which, though probabilistic, can be described as conditions of certainty. However, in the area of decision-making, subjective interpretation is most often required because objective evidence is not available. The constraints and the functions to be maximized are uncertain. Under these conditions, the decision maker must make estimates of the relevant parameters in such a manner that he will be willing to base his subsequent actions on these estimates. There are several techniques available for making such estimates, but the most orderly and consistent technique is the Bayesian probability approach (Bierman, Fouraker, and Jaedicke, 1961).

Using Bayesian concepts, Kadane, Larkey and Shubik (1983) explored the distinction between normative and positive theoretical statements in a game-theoretic context. The frequent confusion between the two statements results from unique epistemological and methodological difficulties linked to cognitive behavior as an object for scientific inquiry. This confusion, they feel, persists because of poor model validation procedures. They believe that game theorists should: (a) understand the differences in the purposes of theories, (b) be as specific as possible about the purposes of the theories, (c) test the theories in accordance with their purposes, (d) test in ways inviting theoretical failure in order to better understand the conditions under which the theories hold true, (e) acknowledge the failures, and (f) aim for more prescriptively and predictively useful theories.

Kadane (1985) has developed a two-person game in which players have diametrically opposed interests and (a) no player uses the Bayesian approach and (b) both unique utility functions and probability distributions are used. He demonstrated that with a unique probability distribution and utility function, players can be involved in a zero-sum game in which their beliefs about uncertain outcomes will be identical, but their preferences for outcomes will be opposite.

Bordley and Wolfe (1981) addressed the problem of aggregating individual probability estimates of an event to derive a group estimate. Their work stemmed from the general belief that no rigorous theory of probability aggregation was possible. This belief was based on two concepts: (a) no consistent way of aggregating individual probabilities exists and (b) although there exists a Bayesian approach, it requires that the estimates of all but one of the experts be independent of the event in question. Bordley and Wolfe, believing the context-free assumption to be unreasonable, developed a theoretical basis for a rigorous aggregation methodology. They clarified the assumptions of context-free and independence to permit what they believe is a valid aggregation.

Game Structure Reports

Harel (1983) believes that the basic management processes of planning, coordinating, and controlling are learned through experience. A management game exercise was structured, with groups of participants assigned the task of constructing the tallest self-supporting structure possible with Tinkertoys or an Erector Set. Each group is given 20 minutes to plan their strategy and 50 minutes to build the structure. Non-participating observers are assigned to each group to record behaviors. Following the construction activity, each group of participants discusses the elements of planning, coordination and controlling they experienced. Discussion may focus on the steps the group took to achieve its task, how the workload was shared, and whether attempts were made to use a planning model to evaluate construction problems. The observer complements participant discussions by commenting on the observed group behaviors and interactions throughout the exercise.

According to Galitz (1982), simulation games in the banking sector are generally structured around the functions of participants and umpires. The participants receive information about the general environment and the present position, analyze the impact of past decisions, and revise strategies with new decisions to facilitate reaching their goals. Umpires are simultaneously analyzing the participants' decisions and preparing a new set of results. Galitz saw this cycle as providing crucial feedback, incentives and involvement.

Waddell (1982) believes that simulation games can be used effectively to help managers and supervisors: (a) gain insight into their own behavior, (b) become sensitive to the perception of others, (c) sharpen analytical decision-making, problem-solving and goal-setting skills, (d) develop skills in dealing effectively with others, and (e) develop skills in risk taking and conflict management. The key element associated with using simulation as a learning/teaching method is the use of feedback. Waddell says two types of feedback may occur: (a) immediate -- through interaction concerning the consequences of the supervisors' actions, and (b) discussion -- the sharing of perceptions. Negotiating sessions, grievance hearings, and planning for human resources and facilities are seen as situations that lend themselves to simulation.

Hogarth and Makridakis (1981) examine the issue of whether the costs of time and effort spent on using simulations to analyze decisions outweigh the benefits accrued. They examined the problem in the context of a competitive business game where teams were confronted with two conditions: (a) rules were applied consistently and (b) rules were subject to a random component. A team applying consistent rules outperformed their opponents 41% of the time; when using random rules, the team surpassed their opponents only 19% of the time. The authors conclude that the findings raise the issue of the need for: (a) a multidimensional approach to organizational decision making, (b) the use of automated and controlled baseline strategies to study decision making in complex situations, and (c) the development of normative guidelines for use in turbulent, competitive environments.

Klein, McDowell and Johnson (1981) describe a variation on a previously mentioned simulation game, the Superior Commander (Cooper 1979), renamed the Organizational Control Game. They investigated how the skill level of game designers impacted on the game. The first series of plays of the game used students as players and the second used former military officers. Students were not found to behave the same way as experienced decision makers in a game environment, leading to the conclusion that the skill level of those involved in the design of a simulation game is an important variable.

In Thimm's (1974) view, dynamic systems thinking is imperative in the initial simulation game design. Given the usual but unanticipated "side effects" found in unique problem-solving ventures, Thimm stresses the importance of broader problem identification, taking into account both external and internal variables. He suggests that concepts from game

theory, decision theory, and systems dynamics be used to develop a PERT-type decision tree of the situation under consideration. The conceptual awareness of role conflict, feedback, and behavioral interaction derived from this process should lead to improved process management and understanding of the decision process involved.

A unique approach to teaching management information systems (MIS) using a management game is presented by Courtney, Bierer and Luckew (1978). Participants first become aware of information needs by interacting in a decision process, then develop an integrated system to assist them in playing the game. This approach is seen as an effective way of teaching integrated systems design because the interrelationships between the decision-making process and information systems can be easily illustrated. Advantages of a gaming method over case studies or lecture methods are seen to include: (a) participants actually become involved in the decision-making process, (b) the approach facilitates the introduction of integrated organizational systems, and (c) other concepts can be illustrated including, for example, the system's life cycle and integrated central data-bases.

In "The Truth or Something Like the Truth," Willmer (1975) argues that for an organization to be effective, management must receive undistorted information from subordinates about the organization's present state and operating environment. He postulates that the more powerful the management, the greater the tendency for them to become isolated from the facts. He further suggests that the degree to which subordinates distort facts depends upon the nature of the opportunities available to them for manipulating information flow. To test this hypothesis, the Manchester Business School designed a business simulation game to explore the effects of various performance appraisal methods on both employee motivation and their manipulation of information flow. The game is highly competitive with participants struggling to control their subordinates. Results from behavior analysis showed that information distortion varies considerably with production targets and perceived penalties.

EXPERIMENTATION AND PERFORMANCE CRITERIA REPORTS

According to Wolfe (1975), management game evaluations have generally demonstrated their efficacy in a learning environment; however, little is known about behavior patterns exercised by players within the game situation. Using a critical incident technique, Wolfe collected 1,453 behavior citations of effective and ineffective performance by 211 students playing one of two different management games. Wolfe found that management games rewarded decision-making practices and that behavior patterns had no significant impact on the outcome of the game.

Wolfe and Chacko (1980), expanding on the above work, examined the effect of cognitive structures of business game players. Cognitive structure (differentiation, complexity, unity, and organization); ambiguity tolerance; and category width were correlated with game playing

behavior. Although some isolated, significant correlations were observed, approximately 89% of the theoretically possible relationships were found to be nonsignificant. Cognitive structure was found to be related to the environment perceived to exist by game participants. These perceptions had a discontinuous effect on playing strategies, but exerted little substantive influence on the results of play.

Wolfe (1976) also examined the external validity of computer-based business games. He compared 74 senior business students and 31 middle management executives before and after playing a comprehensive and sophisticated top-management computer-based simulation. At the outset, the groups were compared on cognitive tests of administrative skills, environmental cognizance, and policy systems regarding comparative knowledge levels. Both groups began from equal knowledge positions but by game's end the students' environmental cognizance scores improved more than those of the business men. Furthermore, the students produced superior outcomes as judged by the financial and economic indicators employed. Wolfe concluded that complex business games have high external validity as business policy and decision-making teaching aids for students with little actual business experience.

The relationship between threat and group decision-making processes was investigated by Gladstein and Reilly (1985). A group of second-year business students with a mean age of 25.2 years were divided into 24 teams. Each team participated in Tycoon, a management simulation game in which the teams interact as hypothetical companies for six full days. Throughout the game, each team was required to make decisions regarding aspects of business (raw material orders, production, schedules) under the influence of a variety of exogenous threatening events (strikes, terrorist attacks). Halfway through the game, the time allowed for the teams to reach decisions was reduced from three hours to 45 minutes. Increased time pressure was found to bring about a corresponding increase in stress and restriction in information processing. These findings, they conclude, indicate partial support for the threat-rigidity hypothesis which posits that external threat leads to restricted information processing and constriction of influence and control.

Biggs and Greenlaw (1976) studied the relationship between the quantity of information available to players and the quality of their decisions. "Amount of information" was defined as the quantity of data and reading material available to players which was relevant to making game decisions. Quality of decisions was assessed using two variables: decision and performance. Thirty-two three-member teams were divided into three groups which received minimal, moderate, or extensive amounts of information. The group receiving the least information performed significantly worse than the other two groups on the performance variable, but no significant differences were found on the decision variables.

Kearney and Martin (1980) assessed the effectiveness of management development instruments (game theory, T-groups, role-playing and in-basket techniques) by surveying 225 personnel and training directors of large manufacturing firms. On-the-job experience and job transfer/ rotation were clearly perceived as greater contributors to management development than any of the instruments. Sensitivity training ranked lowest among the named techniques, with 48% of the respondents stating that sensitivity training was not included in their management development program.

Cabell (1974) examined the relevance of management games as a teaching technique for business students. Students participated in a two-week management simulation, with four different interaction patterns. Experimental conditions included leadership style (participative vs. non-participative) and specialization (product vs. functional) while variables relating to information systems, control systems, and delegation of authority were held constant. The specialization and leadership style variables focused on peer group interactions and the superior-subordinate interactions, respectively. The results indicated that students perceived some degree of relevance between their game duties, decisions, and relationships to the "real world." Perceptions of the relationships between duties were positively related to the specialization variable. However, neither the specialization nor the leadership style variables was related to the students' perceptions of the management game as an opportunity to gain knowledge about the decisions and relationships to be encountered in the real world.

Wilsted and Hand (1974) held that previous goals and performance, as well as a competitor's performance, could be used as predictors of future aspiration levels in a simulated company environment. They tested their hypothesis with business graduate students playing a computer-simulated competitive business management game. The results were seen to support the hypothesis, leading to the conclusion that the test validated the macro-organization theory of goal-setting in a simulated environment.

Burnett (1971) used Tucker's component curve analysis to analyze learning skills. In this study, 20 graduate students were allowed five trials on management decisions to maximize lumber company profits in a computer simulation game. Component curve analysis was used to analyze learning scores measured by total assets for each student ofter five trials. A quartimax rotation in person space showed that 17 of the 20 subjects could be identified using 1 of 3 component curves. Burnett concluded that the utility of component curve analysis for summarizing learning data derived from computer simulation games was demonstrated. He further argued that his findings demonstrated the unsuitability of a single mean learning curve for representing data of this type.

The impact of interpersonal relationships was studied by Deep, Bass and Vaughan (1967), using the Carnegie Tech management game in a 15-week study of integrated decision-making. The participants were assigned to

"companies" in relation to whether they had been in the same or different quasi-training (T) groups 15 weeks earlier. The performance of companies composed of subdivided quasi-T groups was significantly more effective than companies made up of wholly intact quasi-T groups. Although the intact groups reported less internal conflict, they appeared to be less effective as decision-makers due largely to overconfidence in each other's dependability.

Starbuck and Kobrow (1966) explored interpersonal aspects of simulation games by adding advisors to teams playing a business management game. The imposition of advisors reduced the degree of perceived friendliness in the teams' interpersonal relations but did not appear to impact on the amount of time devoted to playing the game.

CURRENT RESEARCH APPROACHES

The application of management simulation games within industry is constantly evolving. A number of current research efforts are exploring how executives think, rather than on the content of their cognitive processes. The interesting finding at this point is that these researchers seem to be independently pursuing the same hypothesis: there is an executive "mind" that is consistent to high performance, but is not captured by routine psychometric measures.

Streufert (1987) uses quasi-experimental simulations that expose participants to a series of complex task demands. The model produces a time-event matrix that depicts the interactions that take place and how one event contributes to solving other tasks. The findings suggest that a "unidimensional" thinker tends to react to new information immediately, rather than seeking inner-dependencies and coordinating decisions toward a strategic major decision. "Multidimensional" thinkers, on the other hand, tend to deal with the crisis by placing it in perspective of the strategic context, drawing on past and projected events to facilitate arriving at a decision. However, throughout the process they are able to maintain and continue their coordinating and seeking patterns of behavior.

Others investigating this difference in thinking include Sternberg of Yale (1987) and Isenberg of Harvard (1987). Sternberg has identified what he terms "tacit knowledge" as a measurement of managerial excellence that is uncorrelated with IQ. Isenberg describes "executive thinking style" as one that involves developing a problem network on several issues at once, looking for interconnections, and then developing options.

The consensus, at least among these researchers, is that complex thinking can be taught, but only within specific, limited situations and then, only with a great deal of patience. Streufert believes that a simulation can be designed for specific industries that will measure complexity and enhance problem solving capability. Sternberg has developed a questionnaire to assess "tacit knowledge" that would appear promising for pinpointing areas that need improvement. Isenberg reports that successful executives rely on intuition much more than others and

often choose a path because it "feels right." However, according to Isenberg, intuition is a cognitive process -- the ability, based on past experience, to see the pattern amid the chaos.

This body of current research is consistent with earlier work that emphasized cognitive complexity and with the Army Research Institute's IODD model shown in Figure 1. The importance of multidimensional, complex thinking continues to be confirmed as the essential cognitive process of executive-level performance. As the Army modifies current simulations or designs new ones for executive development, this capability should have priority.

SUMMARY

This literature review confirmed that simulation games are being widely used in the industrial community. Industry- and company-specific simulations are increasing, as is the popularity of large-scale simulations such as Looking Glass, Inc. and Financial Services Simulation. Proponents of simulation games list a number of benefits to the approach, including the potential for practicing strategic planning and difficult decisions in a no-risk environment -- both critically important to Army executive leadership.

The decade of research and application of simulation games reviewed in this report also demonstrate key principles and issues that can further Army applications. These include:

- Simulation games provide the opportunity to demonstrate inter-relationships of functions, practice, and assess what has been learned including the impact of group behavior.

- Essential elements of management development games are: (a) simulations, (b) feedback, (c) competition, and (d) time-scale.

- Simulation games must allow the following functions to occur: (a) assessment of internal/external threats and opportunities, (b) establishment of objectives, (c) stimulation of higher level/order thinking, (d) identification and evaluation of alternatives, (e) strategy formulation and evaluation, and (f) contingency planning.

- Learning change and growth are best facilitated by an integrated, dynamic, realistic process/environment with the following steps: (a) "here and now" experience, (b) collection of data and observations regarding the experience, (c) analysis of the data with conclusions fed back to the learners, and (d) use of the conclusions for behavior modification and choice of new experiences.

- Simulation game developers must include, in addition to the "technical experts," subject matter experts with experience at the level of decision making/leadership equal to that of the training audience. Simulation games designed by mid-level managers will have limited utility for training executive level leaders.

The literature review also identified two significant short-comings in the current status of simulation games. The first is the lack of "hard" data on the benefit of simulations in terms of learning objectives. This lack was described earlier by Greenlaw and Wyman (1973). After evaluating a number of research studies of game learning, they concluded that very little "hard" research had been done on gaming, especially concerning what the players actually learned in terms of course objectives. They recommended further research to: (a) clarify the incongruencies in existing research, and (b) improve the measurement of intangible factors that affect performance. They also recommended that researchers adopt a cost-utility approach by concentrating on the measurable benefits of existing games, rather than proliferating new ones. Their conclusions and recommendations appear to be equally valid today.

The second short-coming is that current applications appear to be primarily focused at lower to mid-level management. While there is some indication that simulations are being applied to "executive" training, there is no evidence that executive-level training objectives have been adequately identified, or that they are being met.

In light of these short-comings, it appears that current industrial simulation games cannot be considered "ready made" research or training vehicles for Army executives. However, several simulation games and concepts were identified that seem to be relevant to the interpersonal and conceptual skills that are typical of executive-level performance. These selected citations are listed in an appendix as promising targets for further research.

RECOMMENDATIONS

As a result of this literature review, the following recommendations can be made regarding further research and development into simulation games for Army executive development:

- The design principles described in the summary section should be the basis for designing and/or redesigning current and future military simulations.

- The simulation games listed in the appendix should be reviewed and analyzed for their application to Army executive training.

- Existing military simulation games should be evaluated to determine if they can be modified to meet the requirements for training leaders at the executive level.

- The appropriate level of subject matter expert should be an integral member of the simulation development team (e.g., an experienced Corps Commander should be instrumental in the design of Corps-level simulations)

- Simulations should be rigorously evaluated against training objectives.

- Emerging research on "executive thinking" should be explored as potential approaches to simulation-based training.

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APPENDIX

REPORTS OF SIMULATION GAMES SELECTED FOR FURTHER ANALYSIS

Of the 84 reports included in the literature review, the following 12 citations appear to be the most promising in terms of potential for Army executive development. They were selected on the basis of one or more of the following criteria:

- innovative design features
- appropriate level of complexity
- realistic executive environment

1. Gladstein, D. & Reilly, N. (1985) Group decision making under threat: The tycoon game. Academy of Management Journal, September, 613-627.

2. Jones, R. & White, C. (1985) Relationships among personality, conflict resolution style, and task effectiveness. Group and Organizational Studies, June, 152-167.

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